

WEIR (R.F.)

With the Compliments
ON THE
of R. F. Weir
Normal Urethra and its Constrictions

IN RELATION TO

STRICTURES OF LARGE CALIBRE.

BY

ROBERT F. WEIR, M. D.,

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ON THE NORMAL URETHRA AND ITS CON- STRICTIONS, IN RELATION TO STRICT- URES OF LARGE CALIBRE.¹

THE questions to which this discussion has now narrowed itself seem to me to be comprised under two heads: 1. What is the size of the normal urethra; and, 2. What are its normal constrictions? Before presenting to you the views I have been led to entertain on these points, I beg to recall to mind briefly the present status of the discussion. From the remarks made at the meeting of the Society a month ago, it was evident, on the one hand, that the urethra in the dead subject could be distended to the diameter of ten to twelve millimetres in the middle of the spongy portion, and in the bulb from fourteen to twenty millimetres. These measurements correspond very nearly with those of casts I had similarly made in 1870 to illustrate some lectures on this subject, and which I shall presently exhibit to you, with others. And it is proper to remark here, in order to give due weight to such observations as have been made, that, according to Sir Henry Thompson, the method of determining the extensibility of the urethra by injections of wax and fusible metal is one of the best. In

¹ Read before the New York County Medical Society, February 29th, 1876, in the discussion on "Gleet and its Relations to Stricture of the Urethra," inaugurated by Dr. H. B. Sands, January 24, 1876.

addition to the figures just given, those obtained by Reybard¹ by his registering dilator are also presented in the accompanying table.

TABLE I.

DIAMETERS OF THE URETHRA OBTAINED BY

	Fossa Navicu- laris.	Middle of Spongy Portion.	*Bulb.	Mem- branous Portion.	Prosta- tic Portion.
Reybard (1853).....	.....	15½ mm.	18½ + mm.	18½ + mm.	18½ + mm.
Sands (1876), No. 1.....	11 mm.	10 "	14 "	.....	.....
" " 2.....	14½ "	11½ "	16½ "	.....	.....
" " 3.....	14 "	11½ "	14 "	.....	.....
" " 4.....	14½ "	12½ "	20 "	.....	.....
" " 5 ²	13 "	11½ "	17 "	16 mm.	18 mm.
Weir (1870).....	14½ "	13 "	18 "	.....	.....
Civiale.....	.....	.....	.....	19 mm.	.....
Teevan.....	.....	.....	.....	.....	18½ mm.
Dolbeau.....	.....	.....	.....	.....	20 "

To complete this part of the subject it is only necessary to add that, in respect to the membranous portion, Civiale found that it was, contrary to the ideas of many, even at the present time, capable of being distended to a diameter of nineteen millimetres, while from the researches of Teevan and Dolbeau we have been put in possession of the important fact that the prostatic part of the urethra can be dilated without rupture to the diameter of eighteen and three-quarters to twenty millimetres. The practical bearing of these data upon the operation of median lithotomy is evident to you all.

But, on the other hand, it was not only shown by Dr. Otis in the painless passage before you of a sound, of the size of No. 40^f, into the bladder of a living patient, but also by the revelations of the urethrometer, admitted by all of us as an instrument of value in urethral explorations, that the urethra could be dilated in the living subject to a size much beyond what surgeons had been accustomed to. In addition to this, the statement was again brought to your notice that the size of the urethra corresponded to the circumference of the penis,

¹ "Rétrécissements du Canal de l'Uréthre," 1853, p. 12.

² This cast was recently made by Dr. Sands, and is marked A' in the woodcut. The irregularities resulting from the extreme distention are admirably shown, as well as the dilatability of the membranous portion. The urethra of the subject was unfortunately not examined microscopically, but to close inspection showed no abnormalities.

and varied, in a number of cases, at most only a couple of millimetres beyond this fixed ratio. In respect to both these points, I, in common with those interested in this subject, have for some time past critically observed, both in my own practice and in that of others, in order to test the accuracy of these statements; but, while finding by the urethrometer, or by the *bougie à boule*, or by the sound after enlarging the meatus, that the canal was of the larger dimensions stated, yet many exceptions to the given ratio were met with. It was in those cases where incisions were resorted to by the dilating urethrotome that I first learned to distrust the rule. The blade of the instrument would frequently be carried four to six millimetres beyond the indicated size, and the stricture, even after it had been divided according to the rule, found not to equal the urethra in front of it. To escape this confusion, a suggestion in operating was carried out, of cutting the band so long as any obstruction was felt by the *bougie à boule*. However, it was soon ascertained that, after the first incision was made, a bulbous bougie of a sufficiently large size could always be made to catch at the upper angle of the wound. Since then, whenever it has been determined to incise a stricture up to the full size of the canal, the calibre of the urethra is previously ascertained by the introduction of the urethrometer.

This, however, is somewhat of a digression, but it explains the steps in my loss of faith.

The table presented, marked II., shows the results of recent examinations of urethræ that were made, with the co-operation of my colleague Dr. Erskine Mason, and of Drs. Wallace and Heinmüller, Knight and Rice, of the Bellevue and Roosevelt Hospital house-staffs. The upper figures were derived from patients who claimed never to have had any urethral discharge. The lower portion of the table comprises a few whose history in this respect was unreliable or else who acknowledged that they had had gonorrhœa. I give these cases, not only because they were examined with great care and gentleness, resulting from a considerable experience with the instrument, but also for the reason that these examinations were tested by other instruments of like nature, whose construction carried out more fully the principle of the *bougie*.

à boule, in having a shoulder, than the urethrometer of Dr. Otis, which resembles more the ball-probe of Bell. Moreover, as several of these patients had been submitted a short time previously to an exploration, resorted to by Dr. Otis, their satisfactory statement as to the equality of the test, in respect to pain, etc., was of importance.

TABLE II.
SIZE OF THE URETHRA IN HEALTHY LIVING ADULTS.

Number.	Age.	Circumference of Peris.	Meatus.	Bulb, etc.	Ratio.
1	30	3 in.	No. 19	No. 44 + (the utmost capacity of the instrument used) for $\frac{1}{4}$ in.; then 37 for $\frac{1}{4}$ in.; then 31 for $\frac{1}{2}$ in.; then 26, which gave 2 jumps or hitches in next $1\frac{1}{4}$ in.; then 27 to fossa navic., which took 32.	-
2	25	$3\frac{1}{4}$ "	" 24	No. 44 + for $\frac{1}{4}$ in.; then 38 for $\frac{1}{4}$ in.; then 33 for $\frac{1}{2}$ in., with a decided jump; then 28 for $\frac{1}{2}$ in., with jump thence to fos. nav., which took 30.	-
3	42	$3\frac{1}{4}$ "	" 15	No. 44 + for $\frac{1}{4}$ in.; then 32 $\frac{1}{2}$ for $\frac{1}{4}$ in.; then 25 to fos. nav., which took 30.	-
4	36	$3\frac{1}{4}$ "	" 23	No. 33 for 1 in.; then 29 to meatus, making 2 jumps at depth of 2 in.	-
5	45	3 "	" 26	No. 44 + for 2 in.; then 37 to meatus (Weir's measurement). No. 44 for $1\frac{1}{4}$ in.; then 43 for $\frac{1}{2}$ in.; then 36 to meatus (Mason's measurement).	-
6	28	$3\frac{1}{4}$ "	" 23	No. 45 for 1 in.; then 40 for $\frac{1}{4}$ in.; then 33 to fos. nav., which took 35.	+
7	21	$3\frac{1}{4}$ "	" 26	No. 45 for 1 in.; then 37 to meatus—fos. nav. not tested.	+
8	33	$3\frac{1}{4}$ "	" 26	No. 44 + for $\frac{1}{4}$ in.; then 41 $\frac{1}{2}$ for 1 in.; then 40 for $\frac{1}{2}$ in.; then 34 to meatus—fos. nav. not tested.	+
9	19	$3\frac{1}{4}$ "	" 28	No. 38 + for $1\frac{1}{4}$ in.; then 36 $\frac{1}{2}$ for 1 in.; then 34 for $\frac{1}{4}$ in.; then 32 for $\frac{1}{4}$ in. to meatus; with 3 jumps.	-
10	32	3 "	.....	No. 44 + for $1\frac{1}{4}$ in.; then 42 for 34 in.; then 39 to meatus.	+
<i>Supplementary Cases.</i>					
11	27	$3\frac{1}{4}$ in.	No. 23	50 mm. for $\frac{1}{4}$ in.; then 40 for 1 in.; then 35 for 1 in.; then 30 to meatus, with 1 jump.	-
12	42	$3\frac{1}{4}$ "	" 26	45 mm. for $\frac{1}{4}$ in.; then 43 for $\frac{1}{4}$ in.; then 40 for $\frac{1}{2}$; then 35 to meatus.	=
13	35	$3\frac{1}{4}$ "	" 21	No. 39 $\frac{1}{2}$ for $1\frac{1}{4}$ in.; then 37 for $1\frac{1}{4}$ in.; then 34 for $1\frac{1}{4}$ in.; then 25 to meatus.	-
14	35	$3\frac{1}{4}$ "	" 21	No. 39 for $1\frac{1}{4}$ in.; then 37 $\frac{1}{2}$ to meatus.	+
15	13	$2\frac{1}{2}$ "	" 28	No. 30 from perineum to meatus, with a hitch at 2 in. from meatus.	+

Average of spongy portion in ten healthy urethrae, No. 32.1.

From this table the variation in the size of the urethra is seen to be quite marked. In only three out of the fifteen does the ratio hold good. Observe, also, in the boy's case the disproportion; but upon this it is not proper to lay too much

stress, as the rule may be considered to apply chiefly to adults.¹

It must be remembered, too, in justice, that the registration of circular urethral instruments is by the *numbers* of the French scale. Such is the custom, I learn, among all the instrument makers of this city, save in one instance. Hence No. 30 (and the more for the larger numbers), which has a diameter of ten millimetres, has, by multiplying this by the correct multiple of 3.146 (roughly $3\frac{1}{4}$), a circumference of $31 +$ millimetres. As Dr. Otis's ratio is given in millimetres, this should be borne in mind, and while it may diminish the disproportion in the figures below, yet it necessarily increases those above the supposed ratio.

But, as I saw these large sizes of the urethra demonstrated to me, I asked myself, as you have probably asked, Why did previous explorers, who knew of this dilatability of the canal, apparently ignore it and advise the restoration of a damaged urethra only to a certain inferior calibre? That they did so appreciate it a few short quotations will show.

Ducamp,² in 1827, said, in reference to the dimensions of the casts of Sir Everard Home: "We can obtain a radical cure of stricture in the urethra only by restoring it to its natural calibre. Now, if we compare the dimensions of bougies or catheters with those of the canal, we shall see that this result has never been attained, for the largest catheters in use, No. 12, are but three lines in diameter (i. e., No. 19 Fr.)." He also invented the bellied bougie, in order to dilate the canal without doing continued violence to the meatus. Yet he afterward limited his dilatation, etc., to four lines in diameter³ (i. e., 25 Fr.).

Again, Civiale, whom I quote with especial reverence, for

¹ The possible variation in the measurement of the penis itself has not been referred to. This is well shown in a case narrated subsequently in the discussion by Dr. E. L. Keyes, where the different external circumstances, such as cold and warmth, and internal conditions, as a full or empty bladder, without any evidences of erection, gave a circumference which varied on different days from three and five-eighths inches to four and one-eighth inches.

² Translation by Herbert, New York, 1827. p. 4.

³ Page 120.

we must recollect we have in him the experience of a man who had treated fifteen hundred cases of stone, and that, too, in times when *débris* was often drawn through the urethra in the jaws of the lithotrite, a procedure surely calculated to discover the capacity of the canal—Civiale¹ says that, “whatever may be the variations among authors as to the diameter of the urethra, it is clearly demonstrated that the canal is larger than is generally believed.” Yet he restricted dilatation, etc., to a diameter of eight millimetres² (No. 24), coupled, however, with the sage advice to continue the treatment until the gleety discharge ceased.

Richet,³ another eminent French surgeon, gives from 30 to 38 as the measurement of the distended urethra in adults, but he, too, advises that instruments not larger than seven or eight millimetres in diameter (Nos. 21 to 24), should be used. And finally, Reybard⁴ with his knowledge of fifteen and a third millimetres (No. 46), being the diameter of the spongy portion, states that eight and a third to nine millimetres (Nos. 25 to 27) mark the natural diameter of the canal.

Upon what was such a determination founded by these distinguished observers? Upon probably two points: 1st. The inefficiency of the thorough division of strictures by Reybard’s extensive internal incisions, and the failure of external urethrotomy, to effect a maintenance of the calibre of the canal; and, 2d. That these diameters represented to them the size which the ordinary performance of the function of the canal demanded.

It is not amiss, therefore, that a moment or two should be spent on the consideration of this latter point, inasmuch as thus far only the anatomical distention, so to speak, on the living and dead subject, has been entertained. Let us take up the question of calibre in respect to its physiological aspect. The facts germane to this point have been principally elicited by casts obtained by causing some solidifiable substance to gently flow through the urethra in such a manner as to simulate the natural discharge of urine. Some authorities, as Richet, in

¹ “Mal. d’Org. genit.-urinaires,” p. 34, edition 1858.

² Page 33.

³ “Anatom. Medico-Chirurgicale,” p. 739.

⁴ Reybard, “Rétrécissements de l’Urèthre,” 1853.

addition to injections, have endeavored to arrive at the same result, by slitting open the previously-undisturbed urethra, and measuring the width of the canal without any traction being made upon its edges.

The former method approximates so much more nearly Nature's performance of this function, that I have been led to adopt it for the purpose of determining—1st. The size of the urethra in ordinary forcible urination, representing the average physiological distention; and, 2d. The size of the urethra in obstructed urination, representing the extreme of physiological distention.

Inasmuch as the details employed by Richet and Reybard are not given, I have resorted to the following means to arrive at a solution of this question:

EXPERIMENT I.—From a series of trials, in which some friends coöperated, it was found that urine could be projected in adults varying from thirty to forty years in age, and with meatuses from Nos. 22 to 26, a distance three and a half to four feet when the penis was held horizontally and the bladder distended with several hours' accumulation of urine. Forceful and steady expulsive efforts of the abdominal walls were employed on these occasions.

A penis with a meatus of No. 24 was then obtained from the cadaver of a man of twenty-six, and water forced through it by attaching it to the faucet of the wash-basin, which was turned on until the distance acquired by the jet reached four feet, when the urethra was pinched simultaneously, by an assistant, at the meatus and membranous portion, and the imprisoned fluid collected in a graduated measure. This was repeated twice for correctness. The contained fluid was in each instance the same, viz., three drachms. This amount, with three-quarters of a drachm in addition, as an allowance for the fluid retained in the nozzle of the syringe and connecting tubing, in all three drachms and three-quarters, of a preparation of Chinese gelatine and glycerine, liquid at a moderate heat, was forced into the urethra to the same points. In a few minutes sufficient hardening occurred to allow of the cast being withdrawn, as it was exceedingly smooth and slippery.

A second cast was made, but it unfortunately became dam-



A', Forcible distention of a healthy urethra in the cadaver; *A*, Urethra less strongly distended; *B*, Distention of the urethra in full, free urination; *C*, Forcible distention of the urethra in the living subject.

aged ; its measurements corresponded, however, with the first one, showing, of course, only by this, the accuracy in manipulation.

The diameters of this cast, from which those marked *B* were made, are as follows :

At the fossa navicularis,	8	millimetres,
" " end of the fossa navicularis,	8	"
" one and a half inch from the meatus,	8½	"
" the bulb,	14	"

which correspond, it will be seen, quite closely with the diameters accorded to the natural canal by previous observers. The cast also shows a number of transverse irregularities, best appreciated in gently drawing the finger along its moistened surface. It does not, however (nor was this to be expected), show at two and a half or at three and a quarter inches any trace of the strictures detected at these points by Nos. 29 and 30 *bougie à boule*.¹

We have now, I think, a fair representation of what is indicated by the natural distention of the urethra. So, in order to appreciate the dilatability of the canal under the influence of the full power of the bladder and accessory parts, the following procedure was devised :

EXPERIMENT II.—Urine was voided after several hours' retention, and after the flow had become fully established it was directed into a mercurial gauge, with an assistant to mark the height to which the mercury ascended. This was tried several different times ; the expulsive force being exercised up to the point of causing painful distention of the urethral canal.

A mixture of plaster of Paris was then forced into a urethra (of a penis three and a half inches in circumference, and with a meatus of No. 23), which was attached to the gauge until a similar pressure was marked by the column of mercury. It was allowed to harden under this pressure, and the urethra then laid open, the cast removed and measured. The diameters thus obtained were :

¹ See Case No. III., *post*.

At the fossa navicularis,	11½	millimetres.
“ “ end of fossa navicularis,	11	“
“ one and a half inch from meatus,	11	“
“ the bulb,	14	“

This cast is marked *C*, and shows to a still more striking degree the transverse ridges observed in the preceding smaller one, as well as those of Sir Everard Home and Dr. Sands.

Now, these dimensions, with those obtained by the urethrometer, and by solidifiable injections, give us, in recapitulation, the diameter of the middle of the spongy portion of the canal in

Normal micturition, as	8½ to 9 mm., or 26 to 28½ mm. in circumference (Weir, Reybard, etc.).
Extreme of physiological distention, as	11 mm., or 34 mm. in circumference (Weir).
Anatomical distention on living,	a circumference of 32 mm. (Weir), 31.81 Otis (part of canal not stated).
Anatomical distention on dead,	a circumference of 32 to 36 mm., (Sands); 48 mm. (Reybard).

From such data it can be easily understood why those who recognize the rarity of a cure of stricture, from experience in this disease, and from analogies of contractions elsewhere, arrest their endeavors at the point of the natural physiological calibre of the urethra. But those who are yet hopeful of a radical cure, or even only of a tardy return of the disease, carry their incisions or dilatations up to or beyond the point of thirty-two millimetres, the average point of the anatomical distention in the living subject. I confess to be one of those who prefer in gleet to distend the canal up to a large size by sounds, since reading a synopsis of an article of M. Allaire's, published in 1865. From this author I learned to carry the dilatation of strictures causing gleet up to beyond the then-called normal calibre, by dividing the meatus. These dilatations were brought up by me frequently to No. 32, and sometimes beyond, in the belief not only that the recognized strict-

¹“Recueil des Mémoires Médicales et Chirurgicales Militaires,” December, 1865.

ure, in the old interpretation of that term, was thereby more thoroughly stretched, but also, when the gleet was not of such origin, that the pressure exerted by the extra large sound upon both the mucous membrane and the musculature¹ of the prostate was of a most beneficial nature. And it is with satisfaction that I find the present anatomical consideration of the subject justifies this practice.

In respect to the treatment of gleet from strictures of large calibre by incisions, the risks from haemorrhage, urinary fever, abscess, and the more or less permanent curvature of the penis, which is sometimes sufficient to prevent coitus, have always seemed to me to be too great to be lightly resorted to, and especially do I feel more convinced on this point since some observations, begun in 1873, and recently resumed, have furnished stronger reasons for this adverse conviction.

The consideration of these observations is, in reality, that of the second question, What are the normal constrictions of the male urethra, or, rather, of its spongy portion?

In operating, in 1873, upon a boy of thirteen years (with a penis of two and a half inches in circumference) for traumatic subpubic stricture, I found that, after completing the required external perineal urethrotomy, I could pass a No. 30 *bougie à boule* very readily from the perineal wound to the meatus; which latter was large enough to admit No. 28. The urethra readily received this large instrument, save at a point two inches from the meatus, where an arrest or hitch, decided in character, was experienced both in going and in coming. A subsequent inquiry revealed no history of injury at this point.

Some time after this, the same operation was performed upon a man of thirty, at the Roosevelt Hospital, for traumatic stricture. This patient had never had any venereal disease. On passing a No. 30 *bougie à boule* from the wound to the meatus it hitched decidedly at the penoscrotal junction,

¹ It is to this pressure that I attribute the relief afforded to those urinary difficulties and pains which radiate from the prostate as a centre. The analogous benefit derived from stretching the bladder end of the female urethra supports this view. (See *Boston Medical and Surgical Journal*, January 27, 1876.)

both in going upward and in returning. The patient died four days afterward from septicaemia, and the urethra was secured for examination. The pathologist of the hospital, Dr. Delafield, reported that the urethra was normal, and that no evidence of any stricture was to be found by the microscopical examination.

No other opportunity in the living subject has been afforded me of similarly investigating this point, but during the past few weeks I have examined still further in the cadaver whether these constrictions were anatomical or pathological in their character. If the latter, they were to be truly called strictures, as Sir Henry Thompson¹ defines a stricture to be an "abnormal organic contraction of some portion of the urethral canal."

I regret, however, to state that, owing to the recent great demand for penes, the number of examinations made in connection with this point has been quite limited.

I have, however, examined five urethras, and in each have found the so-called strictures of large calibre. In detail, the cases are as follows:

No. I.—From a man about thirty-five years of age, whose penis measured two and a half inches in circumference.² The meatus, which admitted No. 23, was incised to receive No. 40, which was arrested at a depth of two inches, at which point a No. 35 passed with a jump, and was markedly caught in its withdrawal. A No. 32 was also arrested, in entering and returning, at a depth of three and a half inches. These were detected by Otis's urethrometer. To test the value of Richardson's explorer (Fig. 2), it was introduced, and three other strictures recognized adjacent to the one at three and a half inches, and of the same size (i. e., 32): five strictures were therefore recognized. The examination was repeated by Dr. Heineman, the assistant pathologist of the hospital, who, however, only detected four strictures. The urethra was then laid

¹ Thompson "On Stricture," third American edition, p. 68.

² No special importance is attached to this measurement, as considerable traction had been made upon it prior to the record being taken, and also from the fact that the *post-mortem* shrinkage was found to vary considerably.

open and carefully inspected. Its surface was smooth, and indicated neither to sight nor touch anything abnormal. The



Fig. 1.

DR. WEIR'S URETHROMETER.—The rings on the shaft (see Fig. 2) locate the points of arrest, and permit subsequent accurate measurement.



Fig. 2.

B. WILLS RICHARDSON'S URETHROMETER. *Dublin Medical Journal*, November, 1873.
—Both of these instruments have been painlessly distended to their extreme limit in the bulbous portion of the urethra. The numbers indicate millimetres, not sizes.

strictured portions were subsequently examined by Dr. Delafield, and his report was, that "the urethra examined micro-

scopically by him did not differ in appearance from corresponding portions of other healthy adult urethras."

No. II.—From a man of unknown age, penis three and a half inches, meatus twenty-three. By my dilating urethrometer (Fig. 1) raised to thirty-five millimetres, a decided hitch was felt in going and in returning, at three and a half inches. This was corroborated by a *bougie à boule* introduced from the membranous urethra. The canal was then inspected, and appeared and felt normal. Dr. Satterthwaite, the pathologist of St. Luke's Hospital, kindly made the microscopical examination for me, and, in his words, found that "the mucous membrane was apparently unchanged in character, nor was there any marked change in the corpus spongiosum."¹

No. III.—From a patient aged twenty-six; cause of death, phthisis. The penis in the denuded state in which it was received measured two and a half inches in circumference. The meatus admitted No. 24. A *bougie à boule*, size No. 30, was introduced from the membranous urethra, and showed, by its arrest in going and returning, a narrowing at three and a quarter inches from the meatus, and this bougie was again halted at a distance of two and a quarter inches from the meatus by a constriction, through which only a No. 29 could pass, and then with a jump. The urethra was examined by Dr. M. D. Mann, lecturer on clinical microscopy, in the College of Physicians and Surgeons, who reported the mucous membrane and its epithelium unchanged, and that the subconnective tissue was of uniform thickness. Cast *B* was from this specimen.

No. IV.—From a man of unknown age and history; penis three and three-quarters inches, meatus seventeen. This was incised to-day to admit 35, which was arrested at one and a half inches; 33 was then introduced to a depth of three inches, and caught going and returning at that point. The urethra was opened, and is submitted to your inspection. At

¹ As a somewhat rare pathological change, though, from the normal character of the corpus spongiosum and the urethra, not bearing on the present point, there was found in the right corpus cavernosum a mass of fibrous structure, nearly replacing its erectile tissue. This extended over a distance of about three centimetres.

the site of the hitch indicated by the pin, the mucous membrane was apparently more movable than elsewhere, and there were seen two whitish depressions nearly on the same plane but not encircling the urethra. After the lapse of a short time the lines became quite indistinct. My observation was corroborated by Drs. G. A. Peters and M. D. Mann. The urethra will be submitted to microscopical investigation.

No. V.—Also examined to-day and presented as the freshest specimen, from a man aged forty-five, who had had gonorrhœa and chancre; penis three and three-quarters inches, meatus twenty-three. No. 29 caught at two and three-quarters inches. Half an inch farther in, another hitch was felt by Richardson's and Weir's urethrometer raised to thirty-one millimetres. No. 28 passed with perfect ease. On opening the urethra, two partially transverse lines, slightly depressed, and of a uniform color with the adjacent part of the urethra, were found; at six and a half inches a stricture admitting No. 19 was met with.¹

In all there were six examinations, five in the dead and one in the living subject, made of constrictions varying in size from No. 29 to 35, four of which presented under the microscope no evidence of any pathological changes. But, as it may be objected that a minute pathological alteration may in the lapse of time so closely approximate the normal condition as to be indistinguishable by the microscope, it was considered desirable to have, if possible, some additional corroboration of these unexpected results. This end was attained by the examination of the urethra of a boy, about three years of age, whose youth presumably insured freedom from inflammatory attacks. In this child, whose penis measured one and a half inch in circumference, I obtained a similar result. The meatus was enlarged to admit a No. 14 *bougie à boule*, which was arrested at the penoscrotal angle, both ways, and a No. 16 in its turn arrested markedly once between this point and the meatus. This was verified by Dr. Heineman, who has, I

¹ Since the above was written Dr. Mann has made a microscopical examination of the strictures of large calibre, and reports that nothing abnormal was to be seen at the points where Nos. 29 and 31 caught.

desire to acknowledge here, materially assisted me in these researches.

That this child's urethra was not unduly distended is determined by the circumstance that in two living children, each aged four years, a No. 16 was passed by Dr. Beckwith at the Nursery and Child's Hospital, through an undivided meatus to the bulb without inconvenience.

Are these constrictions anatomical, or were they produced by the instruments used? From their equally ready detection by the spindle-shaped instrument of Otis as well as by the *bougie à boule*,¹ and the other more irregularly-shaped instruments, and also from their locality remaining unchanged in the repeated explorations resorted to, I was inclined to the former view. But in the last two specimens the depressions noticed pointed strongly to a duplicature of the mucous membrane, as a cause of the hitching. The microscope did not aid in the solution of this point.

As to the frequency with which these constrictions, if such they are, are to be found, and as to their influence in interfering with micturition I cannot, of course, from such limited data say: but from the smoothness generally observed in the opened urethrae, and from the fact that in the casts *B* and *C*, made from urethrae Nos. II. and III., no trace of any extra constriction is to be seen at the points where the detecting instruments were caught, the inference would be, that they would not interfere with micturition, nor cause any stagnation of urine.

Also, if they are normal constrictions, statistics based upon their non-return after division must of necessity not apply to the question of a radical cure of stricture; and whether they be considered constrictions or duplicatures of the mucous membrane, it must be admitted that our heretofore relied-upon methods of exploration are not sufficiently trustworthy for us to distinguish between normal and abnormal narrowings of the urethra, certainly from No. 29 upward. An amendment to the statement of Dr. Otis is therefore demanded, for he says, "Complete freedom from stricture can only be demonstrated

¹ The *bougies à boule* used had metal stems, with metallic or hard-rubber bulbs.

by the easy passage of a bulbous sound of a size fully equal to the normal calibre of the urethra.”¹

The *bougie à boule* has not been free from the censure of others, for B. Wills Richardson, in the *Dublin Medical Journal* for November, 1873, says: “I believe it to be a deceptive urethral explorer. If, for instance, after having been passed into the healthy urethra to the bladder, it is then gradually withdrawn, the bulb will frequently follow the stem by a series of jumps or jerks, and may thereby lead to the supposition of the presence of a stricture where none exists.” Thompson² also speaks slightly of the instrument.

I should, in concluding this portion of my subject, regret to be understood, from the preceding remarks, as denying the existence of veritable strictures of large calibre; for the pathological changes to which the almost continually-closed urethra is subjected in inflammation, it is well known, can vary from the slightest impairment of the elasticity of its walls, to the severest degree of stenosis. Our mode of detection of such strictures is, however, I am compelled to say, as yet imperfect.

If your patience will permit, I should like to direct your attention, for a few moments, to the normal size of the meatus urinarius, about which some confusion has recently been shown by the views entertained by Dr. Otis.

The narrowing of the meatus urinarius is classed by this author as a stricture in these terms: “In point of fact, besides varying congenitally more than any other orifice of the body, it is more often strictured from disease than any other portion of the body;” and in his work on “Gleet,” etc. (“American Clinical Lectures,” No. x., p. 8), he quotes Henle (erroneously it has been shown) to support his view that the meatus should equal the fossa navicularis in size.

To aid in settling the question of the normal size of the meatus, I have to present the record of one hundred and twenty-five measurements of that orifice in adults. They range from No. 12 to No. 37. Of those below 20 there were, however, but ten; of those above 30 there were but eight. Between 20 and 30 there were one hundred and nine, or 87

¹ “Radical Cure of Stricture,” p. 10.

² *Lancet*, December 11, 1875.

per cent., or, if the numbers were extended, one at each end of the scale, that is, between Nos. 19 and 31 inclusive, there were one hundred and fourteen cases, or 91 per cent.; of these, of No. 19 there were four; 20, three; 21, nine; 22, twelve; 23, thirteen; 24, eleven; 25, thirteen; 26, fifteen; 27, eight; 28, ten; 29, six; 30, seven; 31, three. Most of these cases, it will be observed, occurred between the Nos. 21 to 28, i. e., ninety-one in all, or 73 per cent. This would indicate the range as the normal limit. These data agree very nearly with those given by Civiale, Reybard, Thompson, Henle, Rollet, Phillips, and Voillemier, these authorities making the diameter of the meatus to vary from six to ten millimetres, Nos. 18 to 30.

The casts of Dr. Sands and the Table II. also show that a normal disproportion exists between the meatus and the fossa navicularis. This latter point is also, as would have been supposed, more sensitive to pressure.

In eight of the thirty-eight cases where the urethra was also explored, there was found, within one-quarter to one-half an inch from the meatus, a narrowing which was from one to six millimetres smaller than the meatus itself, and in one case this ran from 30 to 21, nine numbers. This anatomical peculiarity is spoken of by Thompson and others as a congenital contraction, and as of rare occurrence. May it not act, within moderate limits, as the *vena contracta* known to physicists, and so expedite micturition?

When the meatus is narrower than the normal standard, it has been known to originate and perpetuate a cystitis by impairing the relation between the expulsive power and the freedom of escape of the urine. Furneaux Jordan (*Surgical Inquiries*, 1873, and recently in *Lancet* for January 29, 1876) gave several such cases occurring from congenitally small openings, to wit, "a line or two in length," and states that there is no result of stricture that he had not seen follow a small meatus, except retention, extravasation of urine, urinary abscess, and perhaps renal disease.

In concluding these remarks, I beg to recapitulate briefly:

1. That the spongy portion of the urethra is the smallest (except the meatus) and least dilatable portion of the canal.
2. That normal constrictions (or obstructions) are to be

met with in this portion of the canal as small certainly as No. 29, and that the means at present resorted to are insufficient for the differentiation of such from strictures of large calibre.

3. That the healthy urethra in this portion can generally be readily and safely dilated up to an average size of 32 millimetres.

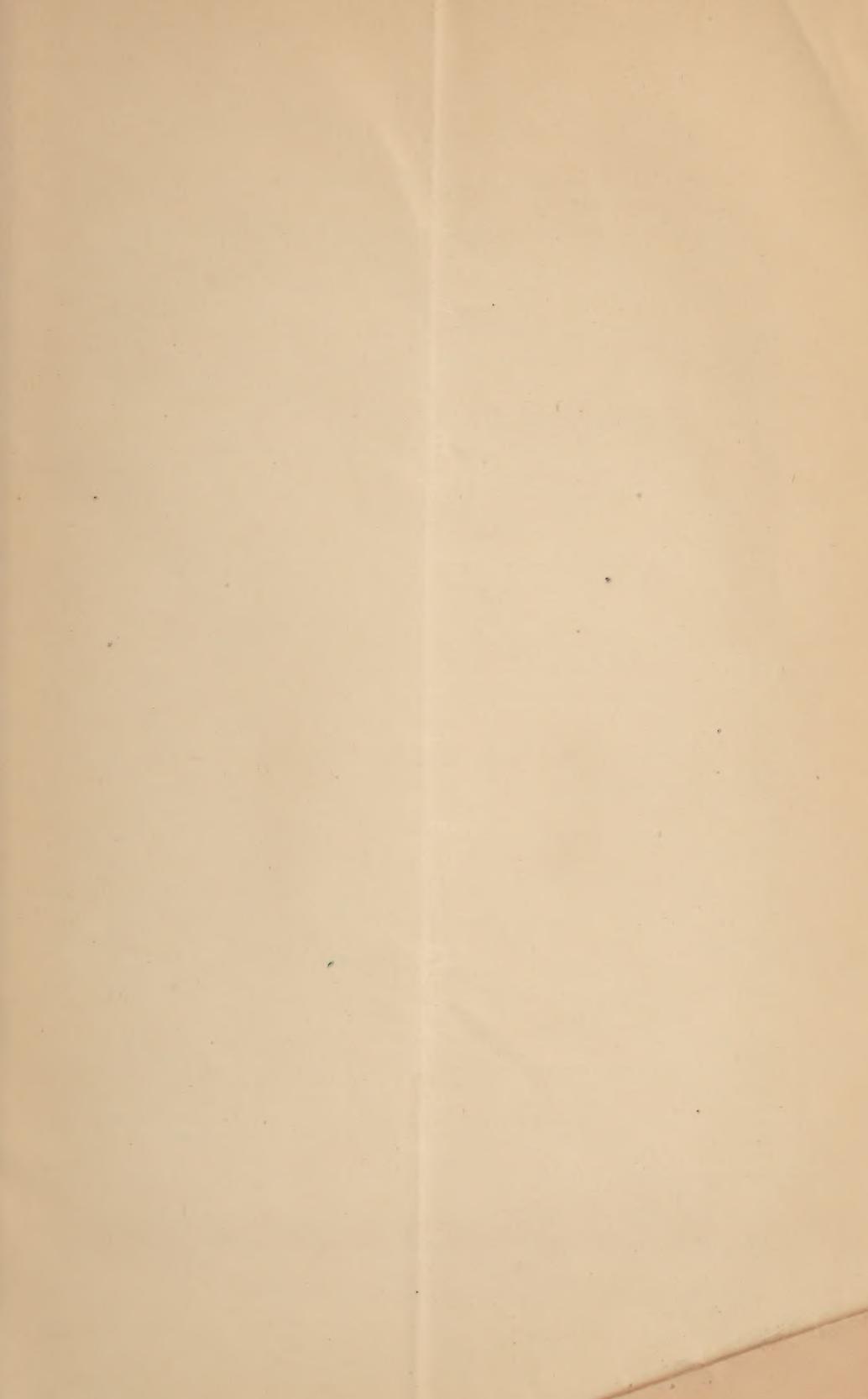
4. That the normal size of the meatus is from No. 21 to 28.

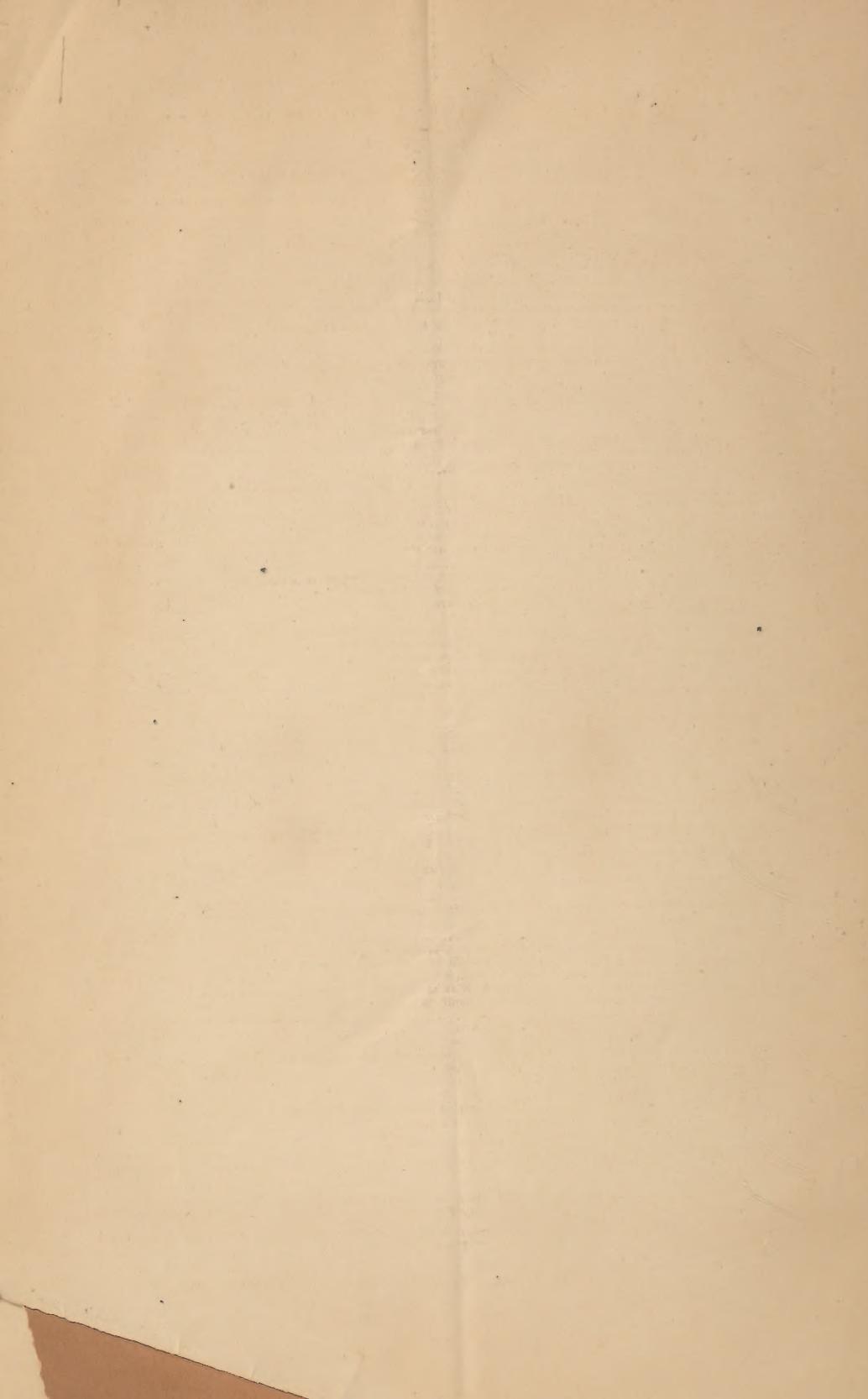
5. That the urethral canal is, in the excellent words of Jarjavay,¹ "narrow at the meatus, dilated in the gland, and very slightly narrowed at the termination of the fossa navicularis; then it forms a cylinder nearly uniform to the prepubian angle, where a coarctation is often found. It enlarges then to the bulb," etc.

It is unnecessary to add this anatomist's description of the deeper portions of the canal, as it is beyond the reach of the present discussion.

¹ "Recherches Anatomiques sur l'Urèthre," 1856, p. 208.







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